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Panel Session: Integrating Software and Hardware for New Observing Strategies

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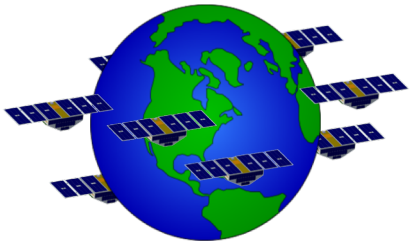
CYGNSS Science Objectives and Mission Design



- **CYGNSS Mission consists of 8 microsatellites, each with a 4-channel GPS bi-static radar receiver**
- **Science Goals**
  - Understand the coupling between ocean surface properties, moist atmospheric thermodynamics, radiation, and convective dynamics in the inner core of a tropical cyclone (TC
- **CYGNSS uses a new measurement technique and a new satellite mission architecture**
  - Measure the distortion of GPS signals scattered from the ocean surface to determine ocean surface roughness and wind speed
  - Use small satellites so many can be flown to improve sampling
  - The constellation lies in a common ~520 km altitude circular orbit at 35^{o} inclination

CYGNSS Pre-launch Development Lessons Learned

- **Constellation assembly and testing**
  - Multiple, parallel, focused engineering models to flesh out systemic design risks
  - First flight model follows more traditional AI&T
  - 2 through N FMs built with less testing at intermediate stages of A&I
- **Redefining reliability at the constellation (not spacecraft) level**
  - Allows for more single points of failure at s/c level
  - Constellation-level redundancy

CYGNSS Mission Operations Lessons Learned

- **Early on-orbit ops for the constellation is not that different in approach, just xN busier**
- **Autonomous routine ground contacts**
  - Once the commissioning phase is over, it is critical to automate the regular, repetitive tasks such as scheduled ground contacts, engineering state-of-health monitoring, and science data downlinks
- **Autonomous recovery from anomalies**
  - Anomalies happen. It is critical for recovery from them to not require extensive manual intervention from the ground, unless they are anomalous anomalies.
  - It is critical to understand and have robust, reliable detection and classification of common and anomalous anomalies
- **Automated command scripting for non-standard ops**
  - Support differential drag s/c attitude maneuvers

CYGNSS Science Investigations Lessons Learned

- **Automated command scripting for non-standard ops**
  - Support a wide variety of science team investigations with special data-taking ops
- **24/7 Operations @ 100% Duty Cycle**
  - Simplifies ground ops
  - Led to discovery of significant new science and applications capabilities from GPS reflections over land